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1. General notes

Affixation is a major way of deriving new words in Welsh. For detailed discussion of different affixes, see Russell (1990) and Zimmer (2000). Compounding is another main strategy, for which see Zimmer (2000) and Russell (2015b). Welsh affixes include many which were abstracted from Latin borrowings, such as the adjectival suffix *-us* (e.g. *deallus* 'intelligent', cf. *deall-* 'to understand') from the Latin suffix *-ōsus* (Russell 2015b: 2774).

There are two kinds of Welsh words which pose a problem for a clear split into inflection and derivation: verbal nouns (from verbal bases) and singulatives. 'Verbal noun' or 'verb noun' (W *berfenw*) is a traditional term for non-finite forms in the Celtic languages (which roughly correspond to participles, infinitives and also deverbal nouns in languages like English); see the general introduction to the Celtic languages for more discussion. Unlike verbal nouns from verbal bases, verbal nouns formed from nouns and adjectives were included in this study, since these clearly involve adding a suffix to derive a new word, e.g. *llygad-u* 'to eye (verbal noun)' from *llygad* 'eye' (noun).[1]

Welsh has two singulative-forming suffixes: *-yn* (masc.) and *-en* (fem.), e.g. *moch* 'pigs', *mochyn* 'a pig' (see Nurmio 2017 and references there). With bases which are count plurals (called 'morphological collectives' by Nurmio 2017), like *moch*, the singulative suffixes can be argued to form inflectional singular/plural pairs. These suffixes also attach to mass and non-nominal bases, however, e.g. *ceirch* 'oats', *ceirchen* 'a grain of oats', and in such cases the addition of the singulative suffix is closer to derivation. The sample nouns included one morphological collective, *llau* 'lice', singulative *lleuen* 'louse'. Here the collective is the base for derivation, and the singulative was not included as a derivative, since it was treated as an inflectional form. The suffixes *-yn/-en* also function as diminutive suffixes when added to singular count noun bases. Such derivatives were included in this study, e.g. *caregyn* 'a small stone, pebble' (from *carreg* 'stone').

[1] The reason that such verbal nouns were not analysed as derived from verbal stems (e.e. *llygad* 'eye (noun)' > *llygad-* 'to eye' (verbal stem) > *llygad-u* (verbal noun)) is that the verbal noun is much more common in use than inflected forms, which supports an analysis that the verbal noun is derived directly from the noun or adjective. This view also seems to be taken by Borsley et al. (2007: 68).

Another theoretical problem is the occasional use of the plural as a stem for adding affixes. In the sample for this study, this may be the case with e.g. *llygeidiog* 'having eyes, having large eyes'. It is not fully clear whether the base is the plural *llygaid* 'eyes', or the singular *llygad* 'eye' with vowel raising regularly caused by the suffix *-iog* (see Russell 2015b: 2774, Russell 1990: 39–60). *Llygeidiog* occurs alongside its synonym *llygadog* based on the singular, and the two were counted as one entry for the purposes of this study, taking the former tentatively as a vowel alternation variant. However, the privative *dilygaid* 'eyeless' must have the plural as its base, and this form was excluded from the derivational network of 'eye'. The noun *dant* 'tooth' also has a different stem *danhedd-* used for some derivatives, e.g. *danheddog* 'having teeth'. Russell (1990: 118–119) has shown that this stem is in origin the oblique stem of this noun, reflecting a preservation of an archaic Brittonic pattern where the oblique stem, not the nominative, was used in word-formation. Although diachronically *danhedd-* is not the plural, it is likely to be understood as such synchronically, and such derivatives were therefore excluded from the derivational network of *dant* 'tooth'.

The common agent and instrument suffixes *-wr* (masc.) and *-wraig* (fem.), e.g. *torr-wr* 'cutter (person or implement)', from *gŵr* 'man' and *gwraig* 'woman' with an initial consonant mutation that deletes /g-/, are treated here as affixoids and therefore excluded from the derivational networks (see Russell 1989: 34–36 and 1996: 121, 125 for further discussion). For other possible affixoids, see Russell (2015b: 2772), and for other agent suffixes, see Zimmer (2000: 551–554).

Welsh has a suffix *-edig* which historically formed past participles from verbal bases, e.g. *toredig* 'broken, cut' from *torr-* 'to cut' (see Russell 1995: 258–259, Russell 1990: 78–79). Synchronically, however, such derivatives are used as adjectives and they do not feature in verbal constructions. The standard grammar by Thomas (2006: 675–676) lists *-edig* as an adjectival suffix, reflecting how it is viewed synchronically (see also Borsley et al. 2007: 69).[2] For perfect aspect ('has done X'), Modern Welsh uses the construction *wedi* + verbal noun (the aspectual marker *wedi* is grammaticalised from the preposition *wedi* 'after'), e.g.

[2] I have included *-edig* derivatives here, arguing that they should be regarded as adjectives synchronically, and not adjectives formed by conversion from a verbal form, even though this may be the case historically. The verbal connection is still apparent in the fact that intransitives often lack an *-edig* derivative, or it is only marginally attested (the present study only includes transitive verbs, however). The same argument applies to derivatives with the suffix *-adwy*, e.g. *llosgadwy* 'burnable' from *llosg-* 'to burn', which originally had a future participle or gerundive force (Evans 1964: 166) but which is now an adjective-forming suffix.

mae	*hi*	*wedi*	*mynd*
be.3SG.PRES.INDIC	she	PRT	go.VERBAL NOUN

'she has gone'

The sources used for creating the Welsh corpus are the *Dictionary of the Welsh Language* (Thomas et al. 1950–), the *Welsh Academy Dictionary* (Griffiths & Jones 1997), the searchable corpora of the Welsh National Corpora Portal (http://corpws.cymru/) and the Welsh National Terminology Portal (http://termau.cymru). Native speaker judgements, and occasional Google searches, were used to verify derivatives the present-day usage of which was not clear from the corpora and dictionaries.

2. Maximum derivational networks

Table 1 shows the maximum derivational network for each word-class per order of derivation. Verbs have the largest derivational networks in all orders. Third- and fourth-order derivatives are rare, and only verbs and adjectives have some fourth order derivatives.

	1st order	2nd order	3rd order	4th order	∑
Nouns	35	15	1	0	51
Verbs	38	31	12	3	84
Adjectives	24	10	3	1	38
TOTAL	97	56	16	4	173

Table 1 Maximum derivational network per order of derivation for all three word-classes

3. Saturation values

Tables 2–4 record the saturation values for nouns, verbs and adjectives respectively, and Table 5 sums up the average saturation value for each word-class. There is much variation in saturation values between different lexemes: the highest value for nouns is 50.98% (*enw* 'name') while the lowest is 5.88% (*llau* 'lice (pl.)'). For verbs, the percentages are 66.67% (*gwybod-/gwybydd-* 'to know') and 1.19% (*rho(dd)-* 'to give') and for adjectives 39.47% (*newydd* 'new') and 13.16% (four adjectives have this percentage, see Table 4). The average saturation values in Table 5 are fairly low for all word-classes, generally staying below 20%, apart from 1st order derivatives of adjectives with the average of 27%.

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Nouns	Saturation value (%)	1st order (%)	2nd order (%)	3rd order (%)
asgwrn 'bone'	13.73	17.14	6.67	0
llygad 'eye'	9.80	14.29	0	0
dant 'tooth'	15.69	17.14	13.33	0
dydd 'day'	21.57	28.57	6.67	0
ci 'dog'	17.65	14.29	20	100
llau 'lice (pl.)'	5.88	8.57	0	0
tân 'fire'	13.73	17.14	6.67	0
carreg 'stone'	17.65	17.14	20	0
dŵr 'water'	19.61	28.57	0	0
enw 'name'	50.98	37.14	86.67	0

Table 2 Saturation values per order of derivation for nouns

Verbs	Saturation value (%)	1st order (%)	2nd order (%)	3rd order (%)	4th order (%)
torr- 'cut'	11.9	23.68	3.23	0	0
clodd- 'dig'	8.33	15.79	3.23	0	0
tynn- 'pull'	17.86	23.68	6.45	25	33.33
tafl- 'throw'	8.33	18.42	0	0	0
rho(dd)- 'give'	1.19	2.63	0	0	0
dal(i)- 'hold'	9.52	13.16	9.68	0	0
gwn- 'sew'	3.57	7.89	0	0	0
llosg- 'burn'	22.62	23.68	32.26	0	0
yf- 'drink'	3.57	5.26	3.23	0	0
gwybod-/gwybydd- 'know'	66.67	42.11	83.87	91.67	100

Table 3 Saturation values per order of derivation for verbs

Adjectives	Saturation value (%)	1st order (%)	2nd order (%)	3rd order (%)	4th order (%)
cul 'narrow'	13.16	20.83	0	0	0

hen 'old'	34.21	33.33	50	0	0
syth 'straight'	13.16	20.83	0	0	0
newydd 'new'	39.47	25	50	100	100
hir 'long'	13.16	20.83	0	0	0
cynnes 'warm'	18.42	25	10	0	0
tew 'thick'	28.95	29.17	40	0	0
drwg 'bad'	23.68	33.33	10	0	0
tenau 'thin'	26.32	41.67	0	0	0
du 'black'	13.16	20.83	0	0	0

Table 4 Saturation values per order of derivation for adjectives

	1st order	2nd order	3rd order	4th order
Nouns	19.999%	16.001%	10%	0
Verbs	17.63%	14.2%	11.67%	13.33%
Adjectives	27.08%	16%	10%	10%

Table 5 Average saturation values per order of derivation for all three word-classes

Orders of derivation

Table 6 shows the maximum number of derivational orders for each of the three word-classes, followed by the average number of orders. Adjectives and verbs have fourth-order derivatives (cf. Table 1), although the numbers are low (one adjectival derivative, four verbal ones), while nouns only have three orders. Verbs have the highest average number of orders, although nouns and adjectives follow close behind. In all three word-classes, a word is likely to have more than one order of derivation.

	Maximum	Average
Nouns	3	1.8
Verbs	4	2.1
Adjectives	4	1.6

Table 6 maximum and average number of orders of derivation

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Derivational capacity

Table 7 shows the maximum and the average derivational capacities for the three word-classes, calculated using the direct (i.e. first order) derivatives. A basic Welsh noun in our sample has on average seven direct derivatives and the maximum number found is thirteen. Verbs have the highest difference between the average (6.7) and maximum (16 for *gwybod-/gwybydd-* 'know') number of derivatives, which means that there is considerable variation between lexemes.

	Maximum	Average
Nouns	13	7
Verbs	16	6.7
Adjectives	10	6.5

Table 7 Average and maximum derivational capacity of the three word-classes

Table 8 shows the average number of derivatives per order of derivation for each word-class. The average Welsh noun in the sample has seven derivatives in the first order, 2.4. in the second order, and 0.1 in the third order. There is no major difference between word-classes in the first order of derivation, but in further orders verbs have more derivatives than nouns or adjectives.

Word-class	**1st order**	**2nd order**	**3rd order**	**4th order**
Nouns	7	2.4	0.1	0
Verbs	6.7	4.4	1.4	0.4
Adjectives	6.5	1.6	0.3	0.1

Table 8 Average number of derivatives per order of derivation for all three word-classes

Correlation between semantic categories and orders of derivation

The most common semantic categories for nouns in the first order of derivation are QUALITY (value 9, i.e. 9 out of 10 nouns have a derivative in this category), ACTION (value 7) and RELATIONAL (value 6). For second order derivatives, ABSTRACTION (value 3) and PRIVATIVE (value 3) each occur with three words, and in the third order we only find a single derivative,

which comes under ACTION.

For verbs, the most common categories in the first order are QUALITY (value 7), ABILITY (value 6) and SINGULATIVE (value 4). In the second order, these are QUALITY and ABSTRACTION (each with value 3). In the third order, QUALITY occurs with two words (value 2), and in the fourth order, ABSTRACTION occurs with two (value 2).

For adjectives, the most common categories in the first order of derivation are STATIVE (value 9), ACTION (value 8) and PROCESS (value 7). In the second order, these are QUALITY (value 4) and STATIVE (value 3). In the third order, only two categories have a value at all (value 1 in each), namely ABSTRACTION and RELATIONAL.

Derivatives of second to fourth orders are few in all three word-classes, and there appear to be no significant correlations between the order of derivation and semantic categories.

Semantic categories with blocking effects

With the Welsh words used in this study, second order derivation is available for 19 out of the 30 sample words, most commonly for verbs. Only 4 words in total have a third order derivative, while 3 of those also have a fourth order one. No word has fifth order derivatives. Not having a second order derivative is, then, very common, and not having a third or fourth order one is the norm. Because of the paucity of affixation beyond the first order, we cannot demonstrate that any particular semantic category systematically blocks further derivation.

Typical combinations of semantic categories

There are no combinations of semantic categories that can really be described as typical, due to the general poverty of derivation beyond the first order in Welsh, as discussed above. Some combinations occur in the network of two different lexemes, e.g. PROCESS > PRIVATIVE for both *carreg* ‘stone’ and *llosg-* ‘burn’. Only one combination, ACTION > QUALITY, occurs with three lexemes (*llosg-* ‘burn’, *clodd-* ‘dig’ and *ci* ‘dog’); this is not enough to constitute typicality.

Multiple occurrence of semantic categories

There are six cases of multiple occurrence of a semantic category in one derivational chain. ABILITY > ABILITY occurs in the network of *torr-* 'to cut': *toradwy* 'broken; breakable' > *toradwyedd* 'breakability'. ACTION > ACTION is also found with *llosg-* 'to burn', and *ci* 'dog' has ACTION > QUALITY > ACTION. ABSTRACTION > ABSTRACTION is attested for *enw* 'name' and *gwybod-/gwybydd-* 'to know' and ABSTRACTION > QUALITY > ABSTRACTION for *gwybod-/gwybydd-* 'to know'. DIRECTIONAL > ABSTRACTION > QUALITY > ABSTRACTION occurs with *tynn-* 'to pull'. Finally, we find the chain REFLEXIVE > ABSTRACTION > REFLEXIVE for *gwybod-/gwybydd-* 'to know': *ymwybod* 'consciousness, awareness' > *ymwybyddiaeth* 'consciousness, awareness' > *hunanymwybyddiaeth* 'self-consciousness, self-awareness'.

Reversibility of semantic categories

The following pairs of semantic categories can occur in reversed order of derivation (of the type AB/BA) in the network of one basic word: ABSTRACTION-PRIVATIVE (for the lexeme *gwybod-/gwybydd-* 'to know'), ABSTRACTION-QUALITY ('to know'), ABSTRACTION-REFLEXIVE ('to know'), CAUSATIVE-QUALITY (*enw* 'name'), PRIVATIVE-QUALITY ('to know'). This means that, for instance, the network of *gwybod-/gwybydd-* 'to know' includes derivatives with a privative meaning based on a derivative denoting abstraction (e.g. *arwybod* 'awareness, cognition' > *diarwybod* 'unexpected, unaware'), and also a derivative with an abstract meaning based on one with a privative meaning (e.g. *anwybodus* 'ignorant, unknowing' > *anwybodusrwydd* 'ignorance').

Reasons for structurally poor derivational networks

Welsh has relatively poor derivational networks compared to many languages in this study. Many of the semantic categories are expressed by means other than derivational affixes. As already stated in the introduction, the categories AGENT, and sometimes also INSTRUMENT, are often expressed with the affixoids *-wr* and *-wraig*, from *gŵr* 'man' and *gwraig* 'woman'.

The category DIMINUTIVE is most commonly expressed by periphrastic means, by modifying a noun with the adjective *bach* 'small'. The derivational diminutive suffixes *-yn*, *-en* and *-an* are not very commonly used, although three nouns in the sample have such diminutives, accepted by native speakers as being possible in spoken usage: *asgwrn* 'bone' (dimin. *esgyrnyn*), *llygad* 'eye' (dimin. *llygedyn*) and *carreg* 'stone' (dimin. *cerigyn* and

caregan). However, *llygedyn* is somewhat lexicalised, with most modern attestations having the meaning 'the smallest amount of; ray, glimmer', e.g. *llygedyn o obaith* 'a glimmer of hope'.

Periphrasis is also the means of expressing semantic categories such as DESIDERATIVE, DIRECTIONAL, DURATIVE, FINITIVE, INCEPTIVE, etc.

HYPERONYMY and HYPONYMY are often expressed by compounding with the adjectival forms *uwch-* 'higher-ranking' (comparative of *uchel* 'high') or *is-* 'lower-ranking' (comparative of *isel* 'low'). The adjective *prif* 'principal, main' can also be used to denote hyperonomy (see Zimmer 2000: 25). New words formed with these adjectives are compounds rather than derivatives, since each adjective also exists as an independent word.

It should be noted that for many of the 30 basic words, there are many derivatives which are attested historically, but which are either no longer in use, or possibly never became productive once they were coined *ad hoc*. Searching through the main dictionary, *Geiriadur Prifysgol Cymru* (ed. Thomas et al.), we often find derivatives with only one recorded attestation, and if no further examples could be found in corpora or on *Google*, such words were not included in the derivational networks.

Conclusions

The average number of derivational orders for the three word-classes in Welsh varies between 1.6 and 2.1; 3rd and 4th order derivations are very rare and no lexeme in the sample has 5th order derivations. Of the three word-classes, verbs have the largest maximum derivational networks in all orders of derivation (see Table 1).

Adjectives have the overall highest saturation value in the first order (27%, Table 5). In the second order, the saturation values vary between 16% (nouns and adjectives) and 14% (verbs), so there is a significant drop between the two orders for adjectives, while nouns and verbs do not change as much between the two orders.

Of the 49 semantic categories used in this study, 26 are available for Welsh lexemes. While some occur commonly for different lexemes (e.g. QUALITY and ACTION, see 'Correlation between the occurrence of individual semantic categories and the order of derivation' above), others are only attested once (e.g. HYPERONYMY, seen in *enw* 'name' > *cyfenw* 'surname'). All in all, almost half of the semantic categories are covered by means other than derivational morphology in Welsh, including compounding and periphrasis.

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